

Douglas A. Ducey
Governor

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY



Henry R. Darwin
Director

via e-mail

May 14, 2015
FPU15-238

Ms. Catherine Jerrard
AFCEC/CIBW
706 Hangar Road
Rome, NY 13441

RE: WAFB – ADEQ Comments – *Progress Report April 27, 2015* and *Progress Report May 4, 2015*; *Steam Enhanced Extraction at the Former Williams AFB, ST012 Site, Mesa, AZ*; prepared by TERRATHERM

Dear Ms. Jerrard:

Arizona Department of Environmental Quality (ADEQ) Federal Projects Unit (FPU) and ADEQ contractors UXO Pro, Inc. and Praxis Environmental Technologies reviewed the above-referenced documents. This is the initial in-depth assessment by ADEQ's thermal remediation contractor Praxis Environmental Technologies. ADEQ appreciates your assistance in clarifying items for our contractor. Questions are provided below.

System and Report Clarification Questions

A. Extraction and Injection

1. Is the actual extraction to injection ratio being evaluated with respect to the Work Plan model? The recent 1.73 ratio is significantly lower than the modeled 2.3 ratio presented in the SEE Work Plan. The average total steam injection rates for this week (36,800 pph) and last week (37,500 pph) are higher than any week since 15-Dec-14 (37,500 pph). However, the weekly average total extraction rates are lower (127 gpm and 131 gpm versus December's 142 gpm), resulting in an extraction/injection water mass ratio of 1.73.
2. What is the water mass ratio if it includes the groundwater encroachment induced by ambient gradients?
3. What is the water mass ratio if it includes the displacement of groundwater as the steam bubble grows?
4. Has groundwater extraction from the UWBZ been increased accordingly to account for increased steam injection and to maintain plume containment? The predicted peak steam injection rate provided in the RD/RAWP for the UWBZ is 8,750 lbs/hr. The current steam injection rate in the UWBZ is 12,600 lbs/hr., or 44% higher than the predicted maximum.

5. What was the steam injection rate before the LSZ25 May 1, 2015 decrease? Steam injection at LSZ25 was decreased to 1,100 lbs on May 1, 2015 in a response to observed increased temperatures at TMP-10.
6. Does the LSZ25 May 1, 2015 steam injection rate decrease imply similar increased temperature conditions in other areas along the perimeter? For example, should injection rates be reduced in LSZ10-SIW, LSZ23-SIW, LSZ0-SIW, LSZ27-SIW and LSZ18-SIW?
7. Did contaminant mass or recovery conditions change or has the contaminant mass extraction rate reached a peak value? The mass of steam injected for the extraction of one pound of contaminant mass has increased from its lowest weekly value on 13-Apr-15 (56 lbs/lb). For the current week, one pound of contaminant was recovered for each 145 pounds of steam injected. Last week was 175 pounds of steam and the week before that 123 pounds of steam per pound of contaminant extracted.
8. Has steam injection been reduced accordingly in nearby injection wells LSZ09 and LSZ23? Perimeter extraction well LSZ38 was taken offline on April 21.
9. Has extraction well LSZ05 been taken offline and/or has maintenance been performed? Extraction well LSZ05 was identified previously as requiring maintenance.

B. Vapor Extraction

10. Which wells are producing the extracted steam? The average weekly extraction rate of steam exceeded 200 scfm (equivalent).

C. Average Temperature

11. Are the temperature data collected prior to removing the damaged arrays included in the historical graph of zone averages?
12. Are the recent increases in zone average temperatures real or the result of including temperatures from TMP-13? Average temperatures in the TTZs of the LSZ and UWBZ have increased. However, a number of monitoring locations remain inoperable (TMP's 6, 7, 9 and 17) since 25-Mar-15. TMP 13 was also off-line although a recent report states some sensors are back online.
13. Are the slow, vertical heat conduction conditions expected to continue? The CZ TTZ shows limited heat gain from UWBZ, suggesting that vertical conduction of heat is very slow through the UWBZ. Similarly, heat conduction at the bottom of the LSZ appears to be very slowly increasing the temperature.

D. Vertical and Horizontal Temperature Profiles

14. Was the pumping strategy in this area of the UWBZ modified? The temperature profile at TMP-3 from 165 to 175 ft. bgs is not consistent with conduction from the underlying LSZ. In addition, an abrupt cooling at ~195 ft. bgs depth suggests an influx of colder water. Was the pumping strategy in this area of the UWBZ modified? Is hydraulic control being maintained in the TMP-3 area?
15. Is hydraulic control being maintained in the TMP-3 area? The temperature profile at TMP-3 from 165 to 175 ft. bgs is not consistent with conduction from the underlying LSZ. In addition, an abrupt cooling at ~195 ft. bgs depth suggests an influx of colder water.
16. Is the TMP-4 temperature array damaged? TMP-4 does not display a typical steam zone profile (dissimilar from nearby TMPs 12, 14 and 15) and is located close to steam injection in well LSZ19-SIW. The apparent uniform steam zone at roughly 100 C from 175 to 225 ft bgs is indicative of a failure in the well seal across the upper portion of this interval. The uniform temperature of near 100 C suggests a lack of pressure if steam is present because the profile should increase in temperature with increasing depth and hydrostatic pressure.
17. Will steam reach TMP-5 in the LSZ? TMP-5 shows little heating in the LSZ, only in the UWBZ.
18. Does the uniformity of the temperature profile from 215 to 225 ft bgs suggest the steam zone is in the vicinity of this TMP? At TMP-10, the temperature is increasing across the entire LSZ interval, including the deepest thermocouple.
19. Is TMP-11 heating within the anticipated heating zone of the UWBZ and is the temperature expected to increase? TMP-11 shows heating in the UWBZ (~175 ft. bgs).
20. Is hydraulic containment maintained near TMP-14? TMP-14 is outside the UWBZ TTZ and is located beyond a perimeter steam injection well (UWBZ13-SIW). No extraction is occurring in the UWBZ outside the TMP-14 location, yet TMP-14 shows heating in the UWBZ (~175 ft. bgs) consistent with heating observed in TMP-3.
21. Will adversely mobilized NAPL in the vicinity of TMP-14 be recoverable by the SEE system? TMP-14 is outside the UWBZ TTZ and is located beyond a perimeter steam injection well (UWBZ13-SIW). No extraction is occurring in the UWBZ outside the TMP-14 location, yet TMP-14 shows heating in the UWBZ (~175 ft. bgs) consistent with heating observed in TMP-3.
22. Is hydraulic containment maintained near TMP-16? TMP-16 is outside the UWBZ TTZ and is located near a perimeter steam injection well (UWBZ16-SIW). TMP-16 indicates nearby steam in the UWBZ outside its TTZ that is consistent with heating in the UWBZ observed in TMP-11.
23. Will mobilized NAPL in the vicinity of TMP-16 be recoverable by the SEE system? TMP-16 is outside the UWBZ TTZ and is located near a perimeter steam injection well (UWBZ16-SIW). TMP-16 indicates nearby steam in the UWBZ outside its TTZ that is consistent with heating in the UWBZ observed in TMP-11.

24. Are inflow conditions monitored and hydraulic containment maintained near the southwest site corner? Temperature monitoring is not apparent at the southwest corner LSZ TTZ boundary beyond TMP-8. Thermocouples installed along the screen of LSZ11-MPE on the southern boundary yield temperatures approaching steam temperatures.
25. Are inflow conditions monitored and hydraulic containment maintained near the west site boundary? Temperature monitoring does not exist on the western boundary or beyond of the LSZ TTZ other than three thermocouples in extraction well LSZ37-MPE. The temperatures along the screen at LSZ37 indicate a steam zone exists in the vicinity.
26. Are inflow conditions monitored and hydraulic containment maintained along the northern site boundary? With the exception of TMP -1, temperature monitoring is not apparent along the northern LSZ or UWBZ TTZ boundaries. Three thermocouples installed along the screen of LSZ28-MPE indicate a steam zone exists in the vicinity.

E. Cumulative Water Extraction by Zone

27. Are water extraction quantities presented by zone accurate, given the acknowledged difference between eductor meter readings and manifold meter readings? Which of the two readings is considered more accurate?

F. Water Balance Rate

28. Please provide a revised calculated net rate that includes an estimate for groundwater encroachment and considers the displacement of groundwater by the growing steam bubble. The water level data are corrected by an estimate for the water level rise therefore the water balance for hydraulic containment should also include an accounting of other groundwater flow sources into the treatment zones.

G. Cumulative Energy Balance

29. Is a significant fraction of the injected energy migrating beyond the TTZs and the expected 10-foot heated zones beyond the TTZ boundaries? The cumulative net energy injected exceeds the worst case energy required to heat all three treatment zones (TTZs) to steam temperature based on the data and calculations presented in Appendix D of the Work Plan.
30. Please provide energy balances for individual treatment zones as each zone acts somewhat independently because of the LPZ. The water mass ratios in the UWBZ and LSZ are different.

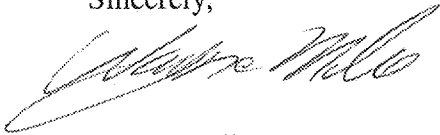
H. Perimeter Water Conditions

31. Does the analysis of perimeter water level data for hydraulic containment consider the presence and growth of the steam bubble? The pressure gradient in a steam zone is different than the pressure gradient in water saturated soil such that some knowledge of the growing steam zone location and volume is desirable for interpreting the water level data.

32. Does the continued occurrence of NAPL in well W37 at volumes significantly greater than historical values indicate the migration of NAPL away from the LSZ TTZ? What level of LNAPL accumulation in W37 or W11 would indicate loss of hydraulic containment?
33. What level of LNAPL accumulation in W37 or W11 would indicate loss of hydraulic containment?
34. What are the depths of temperature sensors in the perimeter monitoring wells that produce data for Figures 24 and 25?
35. Are all boundary areas temperature monitored? Areas near LSZ10-SIW, LSZ23-SIW, LSZ0-SIW, LSZ27-SIW and LSZ18-SIW?

Thank you for your assistance. Should you have any questions regarding this correspondence, please contact me by phone at (602) 771-4121 or e-mail miller.wayne@azdeq.gov.

Sincerely,



Wayne Miller
ADEQ Project Manager
Federal Projects Unit
Remedial Projects Section
Waste Programs Division

cc:	Catherine Jerrard, USAF AFCEC/CIBW	catherine.jerrard@us.af.mil
	Carolyn d'Almeida, U.S. EPA	dAlmeida.Carolyn@epamail.epa.gov
	Terie Glaspey, AFCEC/CIBW	terie.glaspey@us.af.mil
	Steve Willis, UXO Pro, Inc.	steve@uxopro.com
	ADEQ Reading and Project File	